Appendix 2. Supplemental Description of the Delta Wetlands Project Alternatives

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INTRODUCTION

This appendix provides detailed information to augment the description of the Delta Wetlands (DW) project alternatives presented in Chapter 2, "Delta Wetlands Project Alternatives". The following sections provide specifications for DW water storage facilities, including siphon and pump stations, fish screens, and levees; present an overview of patterns of water storage operations under the alternatives; describe recreation facilities and plans; discuss buildings and other structures on the DW project islands that are related to project operations; and describe the agreements, plans, and programs that relate to Delta water project operations and efforts to secure a more reliable high-quality water supply from the Delta.

DW WATER STORAGE FACILITIES

Siphon Stations

Design

Under Alternatives 1 and 2, two new siphon stations with 16 siphons each (spaced 40 feet apart) would be installed on each reservoir island (Bacon Island and Webb Tract). Under Alternative 3, two new siphon stations with 12 siphons each would also be installed on both Bouldin Island and Holland Tract. Each station would include a boat dock (maximum 10 berths) for use by maintenance personnel; a maintenance facility, including a vehicle parking area and living quarters or office space constructed on a pile foundation; and an access ramp near the maintenance facility for equipment loading from the levee road. A minimum of two hinged gangway access ramps would also be constructed adjacent to siphon units for repair access. Each siphon station would be constructed along approximately 900 feet of the perimeter levee and would cover approximately 150,000 square feet (about 3.4 acres). Figure 2-1 of this appendix provides a siphon station plan view.

Siphon Units

Figure 2-2 of this appendix shows a conceptual siphon unit profile. Each siphon unit would consist of the following components:

- a siphon inlet equipped with a fish screen module submerged in the adjacent channel;
- a 36-inch-diameter rigid pipe constructed along the exterior slope of the perimeter levee from the inlet structure to the levee top and installed through the top of the levee to the interior slope;
- a 36-inch-diameter flexible, high-density polyethylene pipe constructed along the interior slope from the levee top into the island interior;
- an expansion chamber supported by a floating platform connected to the flexible pipe in the island's interior; and
- a siphon unit control valve and optional booster pump.

Guard piles would be constructed in the channels beyond the inlets to protect the siphon units. A standpipe for attaching the vacuum pump used to start each of the siphons would be located at the highest elevation of each siphon pipe where it crosses the levee. During operation start-up and shut-down, siphon units would be started and stopped sequentially in each station to avoid creation of bore waves and surges in adjacent channels. Maximum water velocities in the siphon barrels would be approximately 27-29 feet per second (fps).

The flexible pipe constructed along the interior slope of the levee would connect the rigid pipe to the siphon discharges on the island interior. Concrete tracks constructed on the interior slope would support the flexible pipes. The pipes would be equipped with flow meters as required.

The siphon discharges on the reservoir island interiors would be connected to the expansion chambers supported by floating platforms. The expansion chambers would allow the siphon pipes to expand from a 36-inch diameter to a 36- by 120-inch rectangular opening to disperse high-velocity flows and reduce erosion of the reservoir bottoms. Sheet piling or riprap on the island floors also would be used to prevent erosion around the discharge ends. Siphon discharges would be equipped with hinged flap gates to prevent backflow.

In the final stages of reservoir filling, the siphons would be subject to a maximum total head condition ranging from 8 feet at low tide with a full reservoir to a vacuum of 6 feet at high tide with a partially full reservoir. Booster pumps, powered by 50- to 75-horsepower motors, could be installed on the pipes in the floating siphon support platforms to lift water several feet above mean sea level in the final stages of diversions. The booster pumps are an option to facilitate siphon capacity and may not always be included in the siphon design.

Expansion chambers would be fitted to the discharge ends of the siphons on the interiors of the islands, and contraction chambers would be fitted to the inlet ends in Delta channels. These chambers would increase the efficiency of siphon operation and decrease exit velocity of water from the siphon onto the islands. Sheet piling or riprap would be used to prevent erosion around the discharge ends of the siphons.

Fish Screens

Fish screens would be installed around the intake end of each existing and new siphon pipe (Figures 2-2 and 2-3 of this appendix). The purpose of screen design and operation would be to prevent entrainment and impingement of most adult and juvenile fish that are present in the Delta. Final fish screen design characteristics, such as approach velocity, mesh size, flow uniformity, and cleaning frequency, would be negotiated with the U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), and California Department of Fish and Game (DFG) to ensure effective operation under all Delta conditions.

The proposed fish screen design consists of a barrel-type screen on the inlet side of each siphon with a hinged flange connection at the water surface for cleaning (Figure 2-3 of this appendix). Each siphon opening would be enclosed by stainless steel woven wire mesh screen (7 by 0.035 = seven openings per inch in screen of 0.035-inch-diameter number 304 stainless steel wire) with a pore diagonal of 0.1079 inch. Siphon pipes, with their individual screen modules, would be spaced approximately 40 feet apart on center.

DW proposes to design the screens for a maximum average approach velocity of 0.33 fps (or less, if required). The average approach velocity would decrease rapidly as the islands filled because the head differential of the siphons would decrease with island filling. The fish screens would be sufficiently strong to withstand handling and cleaning and would withstand at least a 24-inch head differential in water levels.

The screens would be monitored daily to determine the need for cleaning and to assess damage from floating logs, boats, or other causes. The fish screens are designed with a hinged flange that allows the screens to be rotated out of the water for cleaning and repair (Figure 2-3). The screens would also include panels that allow access to the interior of the screens for cleaning. Spare screen modules would be available to replace damaged screens and thus ensure the reliable performance of the screens. Algae and other clogging debris would be removed from the screens as required by agreement with DFG, USFWS, and NMFS. Removal methods may include regularly raising the screen modules out of the water and using high-pressure water or steam to clean the screens.

A monitoring program may be implemented to estimate fish entrainment losses if the information is needed to evaluate direct diversion effects. Sampling protocol would be subject to fishery agency requirements for the Delta. The monitoring efforts could be coordinated with other regional monitoring efforts.

Pump Stations

Design

The pump stations for Alternatives 1 and 2 would consist of clusters of 32 new pumps on Webb Tract and 40 new pumps on Bacon Island with 36-inch-diameter pipes discharging to adjacent Delta channels. Under Alternative 3, pump stations would include up to 32 new pumps each on Holland Tract and Bouldin Island and 40 new pumps each on Webb Tract and Bacon Island. More pumps would be added to Webb Tract under Alternative 3 to provide for rapid discharge on half of the reservoir islands. Typical spacing for the pumps would be 25 feet on center. Each station also would include a boat dock (maximum 10 berths) on the Delta channel side for use by maintenance personnel, a maintenance facility and vehicle parking area constructed on a pile foundation on the interior side of the levee, and an access ramp near the maintenance facility for equipment loading from the levee road into the island interior. A minimum of one gangway access ramp per eight pumps would be installed adjacent to pump units for repair and maintenance access. Each pump station would be constructed along approximately 1,000 or 1,250 feet of the perimeter levee (the length depending on the number of pump units per station) and would cover approximately 180,000 or 220,000 square feet (about 4 or 5 acres). Figure 2-4 of this appendix presents a pump station plan view.

Pump Units

Figure 2-5 of this appendix shows a conceptual design of a pump unit. Each pump unit would consist of the following components:

- a discharge pump (diesel- or electric-powered) supported by a floating platform equipped with a trash screen bottom to minimize the amount of debris entering the pipe from the reservoir island;
- a 36-inch-diameter flexible, high-density polyethylene discharge pipe constructed along the interior slope of the perimeter levee from the discharge pump unit to the levee top;
- a 36-inch-diameter rigid pipe with a siphon breaker installed through the levee top and along the exterior slope of the levee down into the channel; and
- an expansion chamber connected to the discharge end of the rigid pipe in the adjacent Delta channel.

An assortment of axial-flow and mixed-flow pumps would be used to accommodate the variety of head conditions occurring throughout reservoir drawdown. Head conditions would vary from a maximum total head condition of 31 feet at high tide with an empty reservoir to a vacuum of approximately 6 feet with a full reservoir. The floating platforms would be equipped with trash racks and trash screens to minimize the amount of debris that enters the inlet pipes.

The rigid discharge pipes would connect the flexible pipes constructed along the interior levee slope to the floating pump platforms. Concrete tracks would provide support for the flexible pipes. A siphon breaker and relief valve would be installed at the highest elevation of each discharge pipe to prevent backflow when pumps are not operating. Flow meters would be installed as required.

Outside each island perimeter levee, the 36-inch-diameter rigid pipes passing through the top of the levee would continue along the exterior levee slope into the Delta channel where the discharge ends would connect with expansion chambers. The expansion chambers would allow the pipes to expand from a 36-inch diameter to a 36- by 120-inch rectangular opening. Guard piles would be constructed in the channel beyond the expansion chambers to protect the units, and riprap would be placed on the channel bottom to protect against erosion from the units.

Operation and Power Source

Pump units would most likely be powered by electricity because it is available on both reservoir islands; however, diesel fuel, electricity, natural gas, or a combination of the three are possible power sources. If electrical power is used for pump stations, DW pump operations may need to avoid peak electrical demand periods during summer, requiring up to 25% more pumping capacity from an alternate power source or through other facilities (e.g., portable pumps). If diesel fuel is used either as the primary or secondary power source, a diesel fuel distribution system would be located on the levee tops with a distribution system of pipes and hoses to deliver fuel to the pump motors. A fuel spill recovery system would be implemented at all areas using diesel fuel.

As a supplement to discharge pumping activity, portable pumps or components may be used on the reservoir islands to meet varying discharge requirements but not to exceed the maximum specified discharge rate. The portable components would serve as replacement components and would not add to the permanent facility installation.

Levee Improvements

Under Alternatives 1, 2, and 3, perimeter levees on the reservoir islands would be raised to hold water at a maximum elevation of +6 feet. A typical levee would have 2:1 exterior slopes and a crest approximately 22 feet wide (including thickness for erosion protection [rock revetment] on the interior slope) at approximately +9 feet elevation. The perimeter levee's existing interior slopes would be modified with either a constant-slope buttress or a broken-slope buttress design, as depicted in Figure 2-6 of this appendix. The constant-slope buttress design would be inclined at a slope of approximately 5:1 without toe berms. The broken-slope buttress design would have initial interior slopes of approximately 3:1 down to near an elevation of -3 feet and toe berms at a 10:1 slope at the base of the levee. Rock revetment would be placed on levee slopes to control wind and wave erosion. Seepage interceptor wells would be installed in critical areas on the islands' perimeter levees to offset any changes from existing seepage rates from the reservoir island caused by the DW project.

DW would construct and maintain a series of low, broad earthen levees on the island bottoms to manage shallow water during periods of nonstorage. These levees would be operated during periods of nonstorage to allow no more than 35% of the shallow water habitat to be dry, no more than 15% of the shallow water to be under water more than 24 inches deep, and the balance (50%) to have an average water depth of 12 inches. Pipes with flashboard risers and broad-crested weirs would be used to control water elevations.

Most of the material for levee improvements would be borrowed from the reservoir islands; erosion control material (e.g., rock revetment) would be quarried from existing regional quarry sites. Borrow requirements for the project consist of excavation for levee buttressing, inner levee construction, and levee maintenance. Excavation for construction of drainage canals and circulation ditches on the islands would also provide some of the borrow material. Borrow pits would initially be shallow but would be used regularly in the future for maintenance requirements.

Exact locations of borrow sites would vary according to material requirements for construction and maintenance. Borrow area locations are primarily a function of existing soil conditions and would be determined during site-specific engineering surveys. The borrow pits would generally be more than 400 feet inward from the top of a levee to avoid structural impacts on the levee and at least 2,000 feet inward from the final toe of an improved levee where seepage restrictions are required. Chapter 3D, "Flood Control", provides details of estimated amounts of borrow and rock revetment material needed for perimeter and inner levee improvement for Alternatives 1, 2, and 3.

DW WATER STORAGE OPERATIONS

Patterns of Operations

By converting conventional agricultural land use to a combination of water storage and wetland habitat management, the DW project would modify Delta water budgets. Tables 2-1, 2-2, and 2-3 of this appendix show the simulated pattern of water storage operations on the reservoir islands for Alternatives 1, 2, and 3, respectively, based on the 70-year hydrologic record (1922-1991) and assuming current Delta standards and water project operations.

These tables show the monthly percentiles for simulated diversions, end-of-month storage volumes, and discharges. Percentiles represent the percentages of years in which the cell-entry value is not exceeded. For example, Table 2-1 shows that under Alternative 1, no diversions were simulated to occur in October in 60% of years. DW diversions would be between 0 and 3 thousand acre-feet (TAF) in 10% of years, between 3 TAF and 63 TAF in 10% of years, between 63 TAF and 185 TAF in 10% of years, and between 185 TAF and 238 TAF in 10% of years.

Chapter 3A, "Water Supply and Water Project Operations", and Appendix A3, "DeltaSOS Simulations of the Delta Wetlands Project Alternatives", show more details of simulated DW project operations as monthly percentiles and annual totals. These tables show that the pattern of water storage operations is generally characterized by large diversion, storage, and discharge amounts in small percentages of years.

Initial Staging for Water Diversions

During start-up of the DW project, water diversions would be staged over 1 year to allow time for implementation of accurate seepage control and facility monitoring and to ensure levee stability (see Chapter 3D, "Flood Control"). A typical example of diversion staging might be initial flooding to an elevation of -5 feet, followed by an additional 5 feet of water. After project monitoring (e.g., monitoring of levee stability, seepage rates, and fish), additional water would be added until the islands are filled to capacity or partially filled, based on available supply. Water diversions during initial staging would not exceed the diversion limits designed for the project.

RECREATION FACILITIES AND PLANS

Under the DW project alternatives, DW would construct private recreation facilities on all four project islands. The maximum size of these facilities is described below. Each facility would be constructed on approximately 5 acres along a perimeter levee, providing boat access from neighboring water channels and vehicle access from levee roads.

A conceptual recreation facility layout is shown in Figures 2-7 and 2-8 of this appendix. Each recreation facility would include the following components:

- living quarters (estimate of 10,000 square feet) consisting of a maximum of 40 bedrooms, bathrooms, a kitchen, and dining facilities;
- a 40-car parking lot (estimate of 9,000 square feet) constructed adjacent to the levee crest access road on a pile foundation;
- a 30-berth floating boat dock and gangway constructed on the channel side of the levee to provide permanent and temporary boat berthing for recreationists (estimate of berths 40 feet long) and access to the living quarters from Delta channels; and
- a 36-berth floating boat dock and gangway (estimate of berths 20 feet long) constructed on the interior side of the levee to provide access from the living quarters to hunting areas and other recreation areas on the DW project islands.

The interior boat docks on the habitat islands would be located in permanent water to connect with a network of ditches, canals, and open water that make up the circulation systems on the island bottoms.

The recreation facilities would be used year round by private guests who come to the DW project islands to hunt, boat, fish, and participate in other recreational activities. Use of the recreation facilities would probably be highest during the summer months and during the hunt season. See Chapter 3J, "Recreation and Visual Resources", for more information on recreational use of the DW project islands and the proposed facilities.

The recreation facilities would be built in compliance with the local building codes of San Joaquin County (Bacon and Bouldin Islands) or Contra Costa County (Holland and Webb Tracts). Sewage disposal would comply with the requirements of the Central Valley Regional Water Quality Control Board (CVRWQCB) and local jurisdictions. Pumpout facilities would not be provided for sewage disposal from docked boats at the DW project islands. Drinking water would be imported as needed or supplied using onsite treatment subject to county and state standards. A private solid waste collection and disposal service authorized to operate in Contra Costa County and San Joaquin County would be contracted to serve the recreation facilities, and propane and electrical power would be used at the facilities. Boat-fueling facilities would not be provided to boats docked on the exterior of the islands, but a fuel tank would serve small boats used on the interior of the islands for hunting and maintenance. See Chapter 3E, "Utilities and Highways", for more information on services and utilities for the recreation facilities.

The design details, square footage, and berth lengths given above and shown in Figures 2-7 and 2-8 are preliminary and are used for analysis of the facilities in this EIR/EIS. Specific design features for a particular facility may be subject to change prior to application being made for construction and operation entitlements and permits from regulating agencies (e.g., Contra Costa or San Joaquin County, the State Lands Commission, and the Corps). The analyses presented in this EIR/EIS assume a maximum facility size; actual facility design will not exceed the EIR/EIS assumptions.

BUILDINGS AND OTHER STRUCTURES

Operation and maintenance facilities on the reservoir islands would be located at the pump and siphon station sites. Each pump or siphon station would include a 5,000-square-foot maintenance facility and parking lot constructed on a pile foundation, as described above. A small number of living quarters for some employees and an area for onsite offices may be developed in the maintenance facility areas. The operations buildings would include storage and equipment areas. Other developed areas include the recreation facilities described above, existing developments on Holland Tract in the nonproject areas, and the Bouldin Island airstrip.

RELATED AGREEMENTS, PROGRAMS, AND STUDIES

The agreements, programs, and studies described below are related to environmental conditions in the

Delta and to the quantity and/or quality of available water supply in the Delta. These programs and studies therefore address the general public need for additional water supply in the Delta. The discussion of related Delta programs is based in part on California Department of Water Resources' (DWR's) California Water Plan Update (DWR 1994) and on DWR's draft report Relationships between the Projects under Review by the U.S. Environmental Protection Agency (EPA) (DWR 1991).

Implementation of most of the programs described in this section remains uncertain. These related programs are long-term projects proposed, for the most part, by local and state agencies that have the appropriate financial and planning resources and public support to invest in long-range programs. The programs are not presented as potential alternatives to the DW project, but to provide a context for analyzing potential alternatives for creating a supply of high-quality water in the Delta for later sale for beneficial uses as Delta export and/or outflow and to provide the framework for analyzing cumulative impacts of the DW project alternatives in the context of other proposed Delta projects. The need for the DW project would continue even with implementation of the related water programs.

SWRCB Bay-Delta Proceedings

In 1978, the California State Water Resources Control Board (SWRCB) adopted a water quality control plan, known as the Delta Plan, and Water Right Decision 1485 (D-1485). The Delta Plan contained water quality objectives for the protection of beneficial uses of the Delta and Suisun Marsh.

SWRCB reviewed, broadened, and refined the water quality standards of the San Francisco Bay/Sacramento-San Joaquin Delta (Bay-Delta) estuary during the Bay-Delta hearings. These proceedings, which began in 1987, established reasonable levels of protection for beneficial uses for flow, salinity, temperature, and pollutants. A water quality control plan for salinity, temperature, and dissolved oxygen was completed and adopted by SWRCB in 1991, but was disapproved by EPA because EPA did not believe the plan provided adequate protection for estuarine habitat.

SWRCB subsequently evaluated flow requirements for San Francisco Bay and the Delta and conducted hearings in June, July, and August 1992 to determine whether existing water rights should be amended to achieve, or progress toward achieving, flow and quality standards. On December 9, 1992, SWRCB released interim water quality standards in draft Water Right Decision 1630 (D-1630) to protect fish and wildlife in the Delta and maintain beneficial uses according to the Governor's Water Policy. SWRCB chose not to adopt D-1630.

In response to SWRCB's decision not to adopt interim standards and to the filing of a lawsuit, EPA announced that it would propose draft standards for the Bay-Delta estuary. On January 6, 1994, EPA proposed draft standards for protection of fishery-related beneficial uses in the Delta. SWRCB reviewed EPA's draft standards and conducted public workshops to seek comments and recommendations for standards.

On December 15, 1994, a Bay/Delta Framework Agreement was signed by federal agencies; state agencies; and urban, agricultural, and environmental interests. This agreement:

- identified the amount of water that can be required to be allocated by water rights holders for endangered species protection during average and drought years;
- committed federal agencies not to require additional water allocations for endangered species for a 3-year period;
- placed a limit on the percentage of water that can be exported from the Delta, expressed as percentage of inflow (generally 35% of Delta inflow from February through June and 65% during July through January);
- committed EPA to withdraw its final water quality standards, which were published in January 1995, once SWRCB finalized its water quality control plan;
- dedicated various water users to providing $180 million to fund a variety of improvements to Delta diversion infrastructure; and
- commissioned SWRCB to assign responsibility among the various holders of Delta water rights for maintaining minimum flows during different parts of the year.

Soon after the Framework Agreement was signed in June 1994, SWRCB issued the draft Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (WQCP). This plan set water quality objectives for different points in the estuary, including both numerical salinity objectives and narrative flow and other criteria. These criteria, finalized on May 22, 1995, replaced EPA's draft standards.

CALFED Bay-Delta Program

The Governor's Water Policy (issued in 1992) directed the initiation of the California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) processes to investigate long-term solutions to "fix the Delta". The Bay-Delta Oversight Council was established in December 1992 to guide the search for a long-term solution.

In June 1994, the state and federal governments entered into a Framework Agreement to establish a comprehensive program for coordination on environmental protection and water supply dependability in the Bay-Delta estuary and its watershed. Collectively, these participating agency directors are referred to as CALFED.

Under the Framework Agreement, CALFED will improve coordination of water supply operations with endangered species protection and compliance with water quality standards. CALFED will also develop a long-term solution to fish and wildlife, water supply reliability, flood control, and water quality problems in the Bay-Delta estuary.

CVP and SWP Endangered Species Consultations

On November 30, 1990, winter-run chinook salmon was listed as a threatened species under the federal Endangered Species Act (the species' listing was subsequently changed to endangered on February 3, 1994). Delta smelt was listed as a threatened species on April 5, 1993, and listings of other Delta species (e.g., longfin smelt, Sacramento splittail, and steelhead trout) are being considered. Winter-run chinook salmon and delta smelt are also listed under the California Endangered Species Act. Under the federal Endangered Species Act, a "take" is prohibited unless a specified level of take is authorized by NMFS (winter-run chinook salmon) or USFWS (other Delta species considered for listing) in an incidental take statement. Take is a loosely defined term that includes harassment of and harm to a species, entrainment, directly and indirectly caused mortality, and actions that adversely modify or destroy the species' habitat.

NMFS, USFWS, and DFG have consulted with the U.S. Bureau of Reclamation (Reclamation) and DWR on joint Central Valley Project (CVP)/State Water Project (SWP) operations. Long-term restrictions on project operations to protect winter-run chinook salmon were issued by NMFS in its biological opinion issued February 12, 1993. DFG subsequently adopted NMFS's long-term biological opinion.

NMFS, USFWS, Reclamation, DWR, and DFG are implementing recovery efforts to protect and restore the winter-run chinook salmon, including restricting in-river and ocean harvest, reducing losses to diversions along the Sacramento River (e.g., intakes to Anderson-Cottonwood and Glenn-Colusa Irrigation Districts), implementing artificial propagation, and establishing a captive breeding program. In September 1992, NMFS formed a recovery team to develop a federal recovery plan (required by the federal Endangered Species Act) for winter-run chinook salmon. (DWR 1994.)

Pursuant to the December 15, 1994 agreement between the state and federal governments regarding the water quality standards for the Delta, USFWS issued a biological opinion for long-term protection of delta smelt on March 6, 1995, for CVP and SWP operations. The biological opinion for winter-run chinook salmon was revised in May 1995 and was issued by NMFS in summer 1995.

Coordinated Operations Agreement

The Coordinated Operations Agreement (COA), signed in 1986, provides for joint management of the CVP and SWP by Reclamation and DWR to ensure that water quality objectives established by SWRCB will be achieved. The COA provides not only for an equitable sharing of Delta water supplies, but also for conjunctive operation of the CVP and SWP to allow the projects to maximize benefits to both parties. Under the COA, Reclamation also agreed to meet future water quality standards established by SWRCB, unless the Secretary of the Interior determines that the standards are inconsistent with congressional intent.

Subarticle 10(h) of the COA was approved by Congress in 1988 and provides for negotiations of a wheeling contract between DWR and Reclamation whereby DWR could meet some of its future delivery obligations using federal water, and Reclamation could increase deliveries south of the Delta by using state facilities. Reclamation may have some water available for delivery on an interim basis to areas south of the Delta but has limited pumping and conveyance capacity. DWR, however, has excess pumping and conveyance capacity but limited water supplies.

Scoping meetings for this proposal were held in 1989. A scoping report was released in January 1991. Preparation of a draft environmental impact report/environmental impact statement (EIR/EIS) on this proposal is being delayed until a decision is made on Delta water rights and Bay-Delta water quality and flow standards, and until guidelines for implementing the Central Valley Project Improvement Act (CVPIA) have been adopted (see "Central Valley Project Improvement Act" below).

Banks Pumping Plant Fish Protection Agreement

DWR installed four additional pumping units at SWP's Harvey O. Banks Delta Pumping Plant near Clifton Court Forebay. These units became operational in 1993 and increase total pumping capacity from 6,400 cubic feet per second (cfs) to 10,300 cfs. These pumps provide DWR with standby capacity and allow DWR to pump the quantity of water specified in its U.S. Army Corps of Engineers (Corps) permit over a shorter period. The Corps permit requirements limit pumping to 6,680 cfs plus one-third of San Joaquin River flow at Vernalis during the mid-December to mid-March period whenever those flows exceed 1,000 cfs. An exceedance of this limit would require modification of the existing authorization from the Corps or an individual permit.

To mitigate fish losses at Delta export facilities, both the SWP and the CVP have entered into agreements with DFG. During the environmental review process for installation of the four additional pumps at Banks Pumping Plant, DFG and DWR began negotiating an agreement for the preservation of fish potentially affected by the operation of the pumps. A unique aspect in the development of this agreement was the assistance provided by an advisory group made up of representatives from United Anglers, the Pacific Coast Federation of Fishermen's Associations, the Planning and Conservation League, and the State Water Contractors. (DWR 1994.)

The Fish Protection Agreement, signed by the directors of DFG and DWR in December 1986, identifies the steps needed to offset adverse fishery impacts of Banks Pumping Plant operations. The agreement establishes a procedure to calculate direct fishery losses annually and requires DWR to pay for mitigation projects that would offset the losses. Losses of striped bass, chinook salmon, and steelhead trout are to be mitigated first. Mitigation of losses of other species are to follow as impacts are identified and appropriate mitigation measures are found. In recognition of the fact that direct losses today would probably be greater if fish populations had not been depleted by past operations, DWR also provided a one-time $15 million mitigation fund. (DWR 1994.)

Central Valley Project Improvement Act

Title 34 of the Reclamation Projects Authorization and Adjustment Act of 1992 (HR 429, now noted as Public Law 102-575) is known as the CVPIA. The act makes significant changes to the management of this federal reclamation project and creates a complex set of new programs and requirements applicable to the project. The act covers five primary areas: limitations on new and renewed CVP contracts, water conservation and other water management actions, water transfers, fish and wildlife restoration actions, and establishment of an environmental restoration fund (DWR 1994).

The act establishes a $50 million annual habitat restoration fund and instructs Reclamation to allocate 800 TAF of water annually (600 TAF in a dry year) to the environment by 2002. The act also secures approximately 500 TAF in annual water supplies for Trinity River flows, Central Valley wildlife refuges, and the Grasslands Water District. With certain conditions, the act provides that those receiving CVP water can transfer all or a portion of that water to others. The act restricts new contracts for water supplies from the CVP for any purpose other than to benefit fish and wildlife, and the act requires the establishment of an office for CVP water conservation best management practices.

Reclamation, in its role as operator of the CVP, and USFWS, as directed by the Secretary of the Interior, are beginning to establish the interim guidelines and procedures necessary to implement the act's provisions; however, it will take a number of years to complete all the actions called for in the legislation (DWR 1994). Reclamation is working to complete a programmatic EIS analyzing implementation of the environmental restoration components of the act.

DWR Delta Water Management Programs

DWR is developing water management programs for the south, north, and west Delta. These programs will address the water resource problems unique to each region of the Delta, in the context of the entire Delta, state-wide water supply projects, and the Governor's Water Policy.

North Delta Program

The North Delta Program study area encompasses the Delta region north of the San Joaquin River from Three-mile Slough eastward. Limited channel capacity in the north Delta has contributed to two major problems: reverse flow in the San Joaquin River (a consequence of SWP and CVP exports from the Delta) and repeated flooding of local leveed tracts. The intent of the North Delta Program is to allow greater floodflows to pass safely, while lowering flood levels throughout the area by dredging channels and building new setback levees to provide greater flood protection for Thornton and Walnut Grove and other Delta islands. Increasing channel capacity and reducing or eliminating reverse flows would create a more efficient means of transferring water through the north and central Delta, therefore providing additional water supply for SWP users and improving water quality. The North Delta Program will be investigated as a long-term solution and possibly as an interim action. (DWR 1994.)

South Delta Program

The South Delta Program area encompasses Union and Roberts Islands, Stewart Tract, and other lands near Tracy (DWR 1988a). The program's objective is to reconcile the water supply priorities of Reclamation, the CVP, and the SWP with needs for improved water quality while maintaining recreational opportunities in the south Delta. Water quality problems in the south Delta primarily relate to deleterious effects of water diversions by the CVP and SWP and by agriculture.

The Interim South Delta Water Management Program was initiated in response to an October 1986 agreement between DWR, Reclamation, and the South Delta Water Agency. The Interim South Delta Preferred Alternative includes:

- adding an intake structure for the SWP at Clifton Court Forebay;
- performing limited channel dredging in Old River north of the forebay;
- providing four flow-control structures to control water levels, circulation, and flow in the South Delta channels and to assist salmon migration in the San Joaquin River; and
- obtaining a Corps permit to allow the SWP to increase its existing pumping capacity of the Banks Pumping Plant up to 10,300 cfs during high-flow periods.

The Interim South Delta Water Management Program could augment the water supply of the SWP by an average of approximately 60 TAF per year (TAF/yr). (DWR 1994.)

West Delta Program

The West Delta Program addresses four major issues: flood control, water quality, wildlife concerns, and water supply reliability. The objectives of the West Delta Program are to:

- improve levees for flood control,
- protect Delta water quality,
- acquire island properties for development of diverse waterfowl and wildlife habitats,
- meet water supply and water quality needs of Sherman Island,
- minimize soil erosion and land subsidence,
- protect the reliability of the SWP and the CVP,
- identify potential wildlife habitat mitigation opportunities for present and future development projects,
- protect highways and utilities, and
- provide additional recreational opportunities.

Conversion of land from agriculture to managed wildlife habitat on Sherman and Twitchell Islands is the primary focus of the West Delta Program. Because of their location, 10,000-acre Sherman Island and 3,500-acre Twitchell Island are important for protecting the reliability and quality of the Delta water supply, providing wildlife habitat, and protecting highways and utilities.

DWR published an initial study and negative declaration on the proposed Sherman Island Wildlife Management Plan (DWR 1990b), under which the 10,000-acre Sherman Island would be operated as a wildlife management area by DFG. A framework agreement was signed by DWR and DFG on June 24, 1991, on the suitability of Sherman and Twitchell Islands to serve as mitigation for the Clifton Court Forebay enlargement component or another feature of the South Delta Program.

DWR Delta Levee Maintenance Program

Subventions Program

Maintenance and improvement of levees in the Delta are normally conducted by local reclamation districts using matching funds from DWR or the Federal Emergency Management Agency (FEMA). The procedures and funding for levee work have recently been altered by Senate Bill 34 (SB 34) (the Delta Flood Protection Act of 1988), which increases state funding for flood protection. The DWR subventions program was changed in the following ways by SB 34:

- annual funds available rose from $2 million to $6 million;
- state cost sharing for local assistance programs increased from 50% to 75%;
- reimbursements were made available for levee improvements and maintenance, items formerly disallowed by FEMA; and
- requirements were established for DFG approval of reclamation district plans to ensure that no net loss of wildlife habitat occurs.

Special Projects

In addition to the subventions program adjustments outlined above, SB 34 called for DWR to prepare plans and priorities for flood protection and subsidence studies and monitoring on eight western Delta islands and the towns of Walnut Grove and Thornton. Of the DW islands, Webb and Holland Tracts are included in the eight islands, for which $6 million will be provided annually. The eight islands, if permanently flooded, would pose a significant threat to Delta water quality because of increased evaporation and increased upstream movement of ocean salts and substantial loss of available Delta water supply (DWR 1988b, 1990a). Recent activities include planning and designing major levee rehabilitation projects for Twitchell Island and New Hope Tract; repairing vulnerable levee sites on Sherman Island, Twitchell Island, Bethel Island, and Webb Tract; and conducting other special projects and studies to determine the causes of Delta land subsidence (DWR 1994).

Delta Ecological Studies

DWR, DFG, Reclamation, and SWRCB are participating in an Interagency Ecological Program (IEP) in the Delta. The study program is intended to improve understanding of fish and wildlife requirements in the Bay-Delta estuary and establish operating criteria for the CVP and SWP export pumps to protect fish and wildlife.

Several specific topics are examined in the IEP. The populations, habitat requirements, and effects of flows on striped bass, salmon, and the species of concern and methods of reducing fish kills by pumps and diversions have been explored. Water quality issues have also been investigated, especially algal blooms, drought effects, and improved water quality modeling. Efforts have focused on the Delta, Suisun Marsh, and San Francisco Bay to determine the actions needed to maintain habitat quality in those ecosystems.

DWR Offstream Storage South of the Delta

To increase the amount of water available to SWP customers, DWR has proposed constructing several offstream storage facilities south of the Delta.

Los Banos Grandes

DWR proposed to construct the Los Banos Grandes project, an offstream reservoir complex located on Los Banos Creek in western Merced County, to serve as a south-of-the-Delta water banking unit for the SWP. Los Banos Grandes would store Delta winter flows pumped from the Delta through the California Aqueduct during the wet months (November to April). Los Banos Grandes would be infeasible without the South Delta Program. (DWR 1991.)

A draft EIR was released to the public for review in December 1990. The review and comment period ended September 30, 1991. Los Banos Grandes requires a Section 404 permit from the Corps under the Clean Water Act. A notice of intent to prepare a draft EIS was released in February 1991 with the Corps as the lead agency under NEPA. However, due to the recent Endangered Species Act actions in the Delta and changes to water quality standards, the feasibility of the project is being reassessed. The actual sizing and schedule is highly dependent on the selection of a long-term solution for resolving fishery issues and facilitating efficient water transfer through the Delta.

Kern Water Bank

The Kern Water Bank is defined as the collective opportunity to store and extract SWP water in the Kern County groundwater basin under a contract between DWR on behalf of the SWP and the Kern County Water Agency. The Kern Water Bank consists of eight potential elements or separate components. Seven of the elements would be sponsored by local water districts, and the eighth element would be DWR's Kern Fan Element. A programmatic EIR was completed for the Kern Fan Element in 1986. However, DWR is awaiting an assessment of the availability of future water supply for the project. For now, the planning program is focused on completion of a habitat conservation plan, incidental-take permits for terrestrial species in the Kern Fan Element area, and analysis of project economics. Once an adequate water supply is identified, the Kern Fan Element will be reassessed, final environmental documentation will be issued, and a program for further evaluation of local elements will be considered. If feasible, the Kern Fan Element would be developed to store as much as 1 million acre-feet (MAF) of water and contribute as much as 140 TAF per year to the SWP in drought years.

SWP Coastal Branch Project, Phase II

The Coastal Branch Project, Phase II, will complete the Coastal Branch of the SWP's California Aqueduct. The 102-mile buried pipeline would transport SWP water to San Luis Obispo and Santa Barbara County Flood Control and Water Conservation Districts. This project would deliver a total of about 5 TAF/yr to San Luis Obispo County and 42 TAF/yr to Santa Barbara County.

The final EIR for the Coastal Branch Project was released in May 1991 and the notice of determination was filed in July 1992. Construction began in late 1993 and is scheduled to be completed in early 1997 (DWR 1994).

CCWD Los Vaqueros Project

The Los Vaqueros Project, under construction by Contra Costa Water District (CCWD), will consist of a 100 TAF reservoir within the Kellogg Creek watershed and associated appurtenant facilities, including a new supplemental Delta intake location, conveyance pipelines, a transfer reservoir, pumping plants, and other facilities necessary for project operation. Water diverted from the new Delta intake location will be pumped to the Los Vaqueros Reservoir site during periods when Delta water quality is good. In late summer and fall, when Delta water quality deteriorates, reservoir water to be used within CCWD's service area will be released and blended with Delta water from direct diversions from Rock Slough to reduce salinity.

CCWD has a contract with Reclamation, under Reclamation's existing water right for CVP water, for 195 TAF/yr, which would be adequate to meet CCWD's future water needs. Because of physical constraints in CCWD's delivery system, current diversions are limited to approximately 135 TAF/yr. Currently, CCWD diverts approximately 120-130 TAF/yr of water from Rock Slough, the amount diverted depending on the water-year type. CCWD can also divert up to 26,780 af/yr of water from Mallard Slough in the Delta, although water is rarely diverted because of poor water quality. The Los Vaqueros Project would change the timing of CCWD's diversions and could affect the proportion of water diverted from the Delta during various times of the year.

A draft EIR/EIS for the Los Vaqueros Project was issued for public review on March 3, 1992. After public review, a final Stage II EIR/EIS for the Los Vaqueros Project was published on September 27, 1993, and a Section 404 permit was issued by the Corps in May 1994. A water right decision on the project was issued by SWRCB in June 1994.

Montezuma Wetlands Project

The Montezuma Wetlands Project, a privately financed project, would use deposited dredged materials on a diked bayland site adjacent to the Suisun Marsh in Solano County to restore 1,822 acres of tidal wetlands (including some seasonal wetland features). The proposal calls for constructing facilities to receive up to 20 million cubic yards of approved dredged materials from ports and navigation channels in the San Francisco Bay estuary and to distribute the dredged materials over the site to raise the subsided land surface to an elevation range at which marsh habitat could become established.

The project's potential benefits include restoration of a tidal marsh ecosystem at a scale unprecedented for the region, which could support abundant wildlife, fish, estuarine production, and a diversity of marsh species (including special-status species) and habitats. The project would also provide significant capacity for disposal of sediments dredged from Bay Area ports or navigation channels. The project's potential adverse impacts include loss of established seasonal wetlands and endangered species populations and a possible release of contaminants from dredged materials into the marsh system.

A draft EIR/EIS for the Montezuma Wetlands Project was issued by Solano County and the Corps in October 1994 (Corps and Solano County 1994). The public review period for the EIR/EIS ended on December 19, 1994. A final EIR/EIS is expected to be completed in July 1995 (Glas pers. comm.).

Delta Water Transfers

Water obtained under a water right can be transferred by the water right holder to another party. Water transfers can be used to help meet water supply shortages with possibly fewer environmental impacts and less cost than construction projects. Short-term (1 year or less) temporary transfers require SWRCB approval but are exempt from CEQA compliance, whereas long-term transfers require full CEQA compliance.

SWRCB must approve water transfers that require changes in terms or conditions of existing water right permits. SWRCB does not intend to approve long-term transfers through the Delta until a full assessment of cumulative environmental impacts is prepared.

DWR (1994) describes the functioning of the 1992 State Drought Water Bank, a temporary water transfer program, and provisions of the CVPIA regarding water transfers.

Reoperation of Folsom Dam and Reservoir

Reclamation and the Sacramento Area Flood Control Agency (SAFCA) are considering options involving the reoperation of Folsom Reservoir to permit the containment of a 100-year or larger flood event in the American River watershed. The options are interim measures until the Corps completes a study of permanent reoperation of Folsom Reservoir and a plan is authorized by Congress. Two interim reoperation options, which would maintain maximum flood storage capacities at Folsom Reservoir of 670 TAF and 800 TAF, respectively, were analyzed by Reclamation and SAFCA in an environmental assessment/EIR (EA/EIR). The EA/EIR found that substantial impacts on water supply, hydropower, and other resources dependent on water surface elevations in the reservoir can be avoided or mitigated (SAFCA and Reclamation 1994).

This study evaluates the impacts of increasing the dedicated flood control space in Folsom Reservoir. Study results will be used to decide whether Folsom Dam and Reservoir will be reoperated on a permanent basis to provide increased levels of flood protection to the Sacramento area. If reoperation occurs, storage space now used for water supply, power production, and recreation would be used instead for flood control mitigation. A draft reoperation plan and draft EIS will be issued in 1995. When completed and authorized by Congress, the plan will replace Reclamation's and SAFCA's interim reoperation plan described above.

East Bay Municipal Utility District Activities

American River Diversions

The East Bay Municipal Utility District (EBMUD) contracted with Reclamation in 1970 to purchase up to 150 TAF/yr from the American River watershed for delivery by diversion into the Folsom-South Canal at Nimbus Dam, immediately below Folsom Reservoir. In 1972, the Environmental Defense Fund and others filed a lawsuit that seeks to prevent EBMUD from diverting water from the American River; Reclamation was not a party to this lawsuit. In late 1984, the court appointed SWRCB as referee and directed the board to conduct an investigation and prepare a report on 21 specific legal, technical, and public trust issues.

In June 1988, SWRCB issued its final report responding to the instructions of the court. SWRCB recommended that EBMUD be allowed to divert water from the Folsom-South Canal subject to specified river flow limitations.

A final decision was issued in May 1990 by the court. According to this decision, EBMUD may divert 150 TAF/yr of water from the Folsom-South Canal pursuant to the contract of December 22, 1970. Instream flow requirements are set at 2,000 cfs for October 15 through February, 3,000 cfs for March through June, and 1,750 cfs for July through October 15. However, the current EBMUD board has decided not to divert water from the American River at this time.

Water Supply Management Program

In 1989, EBMUD developed a Water Supply Management Program to identify the actions and projects necessary to provide a dependable water supply to communities of the eastern San Francisco Bay Area. One action proposed by the program was the construction of a 145-TAF terminal reservoir called Buckhorn Reservoir. In January 1989, EBMUD released the final EIR and the technical report for the district's program. The final EIR was the subject of litigation, and EBMUD decided to reevaluate the proposed project and other facility improvements.

A new EIR/EIS for the updated Water Supply Management Program and water supply improvement projects was prepared by EBMUD and the Corps. The present program includes six options: one involving raising Pardee Reservoir, two groundwater banking options using either American River or Mokelumne River water, a Delta diversion option using American River water under the EBMUD contract with Reclamation, a conservation-only option, and an option for groundwater use only. EBMUD has identified a need for 130 TAF of water in 2020.

After several hearings and extensive evaluation, EBMUD's board of directors designated two of the six composite programs as preferred alternatives. The main element of each alternative is the use of groundwater storage. One of the preferred alternatives would store available surface water in an underground basin during wet years and draw from the storage during dry years for agricultural irrigation to augment flows in the lower Mokelumne River or pump into the aqueducts for use by EBMUD's customers. Another preferred alternative includes the same components mentioned above, plus a supplemental water supply from the American River. (DWR 1994.)

Activities of the Metropolitan Water District of Southern California

Arvin-Edison/Metropolitan Water District Storage and Exchange Program

The Arvin-Edison Water Storage District (Arvin-Edison), in partnership with the Metropolitan Water District of Southern California (MWD), is proposing a water storage and exchange program that would extend through 2035. During years of storage (when additional SWP water is available), MWD would store SWP water in Arvin-Edison's groundwater basin. During years of recovery, MWD would receive a portion of Arvin-Edison's CVP supplies in exchange for water MWD previously placed in storage in Arvin-Edison. The proposed alternative would result in the additional diversion of approximately 1 MAF from the Delta over the approximately 45-year life of the program. (EIP Associates 1992.) A draft EIR/EIS was issued in January 1992. However, recent actions to protect aquatic species in the Delta and implementation of the CVPIA have restricted operations in the Delta. Consequently, MWD and Arvin-Edison are currently reassessing the project (DWR 1994).

Domenigoni Reservoir Project

The proposed reservoir in western Riverside County would be constructed in Domenigoni Valley near the junction of the Colorado River Aqueduct, the San Diego Canal, and the SWP East Branch Aqueduct. The reservoir would have a capacity of 800 TAF. The reservoir would receive water, when available, from various sources through the Colorado River Aqueduct and SWP delivery facilities with some shift of SWP deliveries from summer to winter. The project would provide emergency storage, carryover, seasonal storage; preserve operating reliability; provide substantial wildlife mitigation; and optimize groundwater recharge programs. (DWR 1994.)

A draft EIR was issued in June 1991, and a final EIR was issued in October 1991. The final EIR was certified early in 1992, and mitigation and construction design is ongoing. The current MWD schedule indicates that the project would be operational by the end of this decade. However, it could take about 5 or more years to fill the reservoir, so the full benefit of the reservoir may not be realized until after 2004 (DWR 1994).

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Appendix 2, Table 2–1. Monthly Percentiles for Simulated Diversions, End–of–Month Storage Volumes, and Discharges for Alternative 1

Percentile	October	November	December	January	February	March	April	May	June	July	August	September
DW diversion (TAF)												
0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	1	0	0	0	0	0	0	0	0
50	0	0	1	1	2	3	0	0	0	0	0	0
60	0	1	1	1	2	3	0	0	0	5	0	0
70	3	1	1	14	2	3	0	0	0	5	0	0
80	63	54	24	65	2	3	4	6	0	5	0	0
90	185	238	107	204	137	5	4	6	2	5	4	44
100	238	238	238	238	222	238	11	18	7	8	7	238
Mean	39	41	31	42	24	13	1	2	1	3	1	22
DW storage (TAF)												
0	0	0	0	(0)	0	0	(0)	(0)	0	(0)	(0)	(0)
10	0	0	0	0	0	0	0	0	0	(0)	(0)	(0)
20	0	0	0	0	14	56	7	0	0	0	0	0
30	0	0	0	61	174	218	151	110	86	0	0	0
40	0	0	2	236	233	232	196	148	131	5	0	0
50	0	0	148	238	236	235	229	176	155	34	0	0
60	0	196	225	238	238	238	234	209	185	88	0	0
70	39	238	238	238	238	238	234	227	194	138	0	0
80	201	238	238	238	238	238	238	232	225	161	6	0
90	238	238	238	238	238	238	238	238	233	183	80	164
100	238	238	238	238	238	238	238	238	238	238	238	238
Mean	65	105	122	162	175	181	167	148	135	75	23	26
DW discharge for export (TAF)												
0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	27	0
70	0	0	0	0	0	0	0	25	0	70	61	0
80	0	0	0	0	0	0	37	29	8	160	116	0
90	0	0	22	0	0	0	46	51	35	202	164	71
100	0	31	205	166	222	165	79	113	168	230	230	201
Mean	0	1	13	2	10	5	12	16	8	56	49	18

Source: Results from DeltaSOS simulation of Alternative 1 based on hydrologic record for 1922–1991 (70 years) (see Appendix A3).

C-061196

Appendix 2, Table 2–2. Monthly Percentiles for Simulated Diversions, End–of–Month Storage Volumes, and Discharges for Alternative 2

Percentile	October	November	December	January	February	March	April	May	June	July	August	September
DW diversion (TAF)												
0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	1	0	0	0	0	0	0	0	0
50	0	0	1	1	2	3	0	0	0	0	0	0
60	0	1	1	1	2	3	0	0	0	5	0	0
70	3	1	1	6	2	3	0	0	0	5	0	0
80	63	54	24	61	2	3	4	6	0	5	0	0
90	185	238	107	204	137	40	4	6	2	5	4	44
100	238	238	238	238	222	238	186	19	7	8	7	238
Mean	39	41	31	40	24	14	5	2	1	3	1	22
DW storage (TAF)												
0	0	0	0	(0)	(0)	(0)	0	0	(0)	(0)	(0)	(0)
10	0	0	0	0	0	0	0	0	(0)	0	(0)	0
20	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	61	14	0	0	0	0	0	0	0
40	0	0	2	226	145	15	30	8	0	0	0	0
50	0	0	174	238	222	226	200	99	0	5	0	0
60	0	196	233	238	238	238	225	169	0	5	0	0
70	39	238	238	238	238	238	234	204	62	5	0	0
80	201	238	238	238	238	238	238	232	147	28	0	0
90	238	238	238	238	238	238	238	238	233	137	4	164
100	238	238	238	238	238	238	238	238	238	238	238	238
Mean	65	105	125	161	147	133	130	111	61	30	9	26
DW discharge for export (TAF)												
0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	16	7	0	0	0
80	0	0	0	0	59	11	0	28	132	27	0	0
90	0	0	8	0	186	142	25	54	195	160	57	0
100	0	31	205	167	222	235	63	231	225	230	230	170
Mean	0	1	11	3	37	27	5	17	46	30	18	5

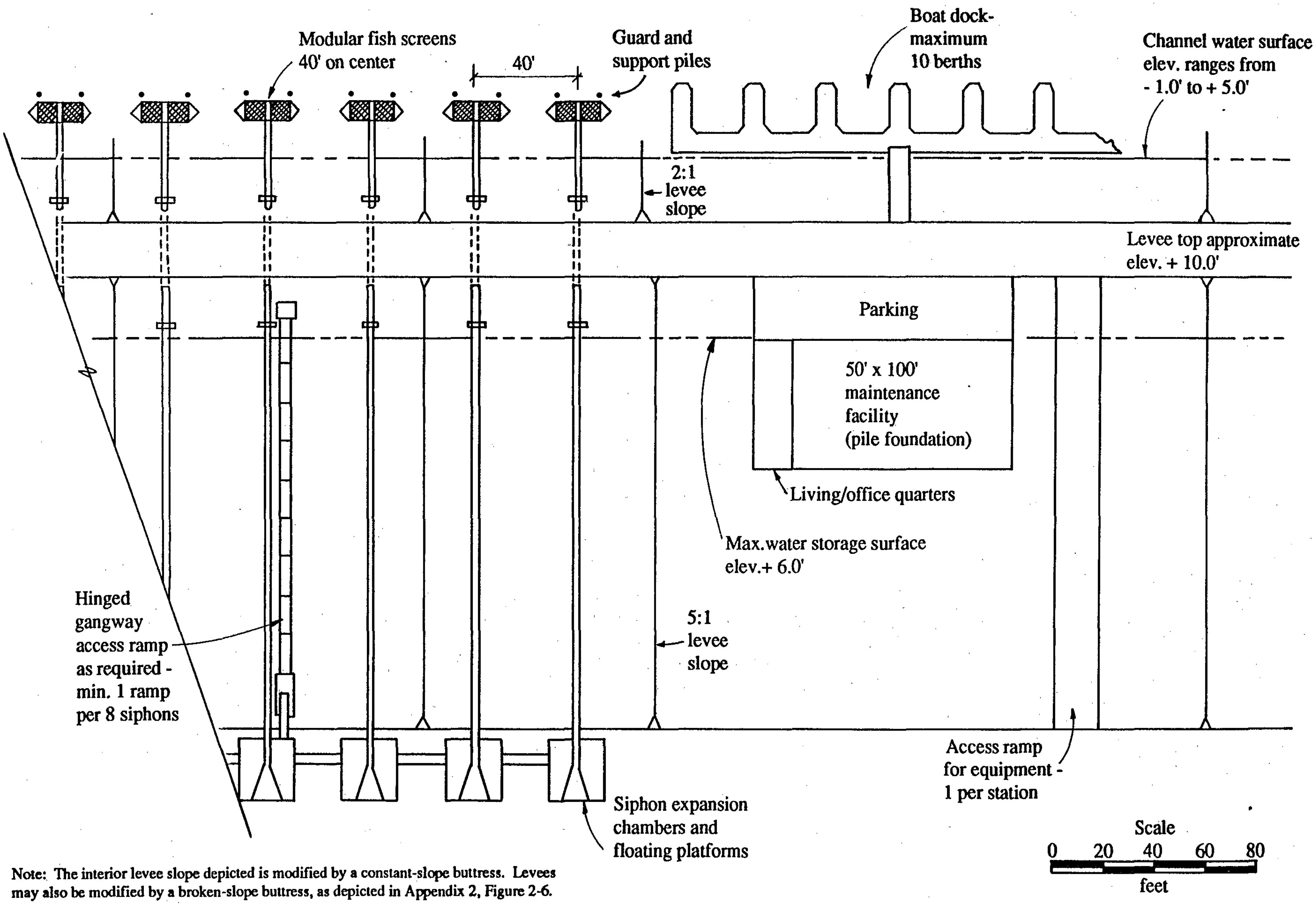
Source: Results from DeltaSOS simulation of Alternative 2 based on hydrologic record for 1922–1991 (70 years) (see Appendix A3).

C–061197

Appendix 2, Table 2–3. *Monthly Percentiles for Simulated Diversions, End–of–Month Storage Volumes, and Discharges for Alternative 3*

Percentile	October	November	December	January	February	March	April	May	June	July	August	September
DW diversion (TAF)												
0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	2	0	0	0	0	0	0	0	0
50	0	0	2	2	3	6	0	0	0	0	0	0
60	0	3	2	6	3	6	0	0	0	10	0	0
70	6	14	50	39	3	6	0	0	0	10	0	0
80	150	145	68	98	39	6	9	12	0	10	0	0
90	231	339	259	204	178	47	9	12	2	10	8	46
100	368	356	368	368	333	368	178	30	14	16	14	356
Mean	61	68	59	60	42	20	7	3	1	5	1	26
DW storage (TAF)												
0	0	0	0	(0)	(0)	(0)	0	0	(0)	(0)	(0)	(0)
10	0	0	0	0	0	(0)	0	0	(0)	0	0	0
20	0	0	0	0	1	0	0	0	0	0	0	0
30	0	0	0	102	107	0	0	0	0	0	0	0
40	0	0	5	275	265	123	129	102	0	10	0	0
50	0	0	248	369	337	364	360	234	37	10	0	0
60	0	197	369	406	406	406	387	312	95	31	0	0
70	42	357	402	406	406	406	397	368	209	66	0	0
80	201	406	406	406	406	406	406	394	298	160	8	0
90	406	406	406	406	406	406	406	406	394	275	64	166
100	406	406	406	406	406	406	406	406	406	406	406	406
Mean	94	161	208	263	259	232	227	206	127	76	21	34
DW discharge for export (TAF)												
0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	9	0	17	60	0	20	0
80	0	0	0	0	66	68	2	26	195	90	54	0
90	0	0	8	0	196	158	25	51	278	164	211	41
100	26	28	230	167	333	305	61	184	291	368	321	233
Mean	0	1	11	4	43	42	5	17	70	48	48	11

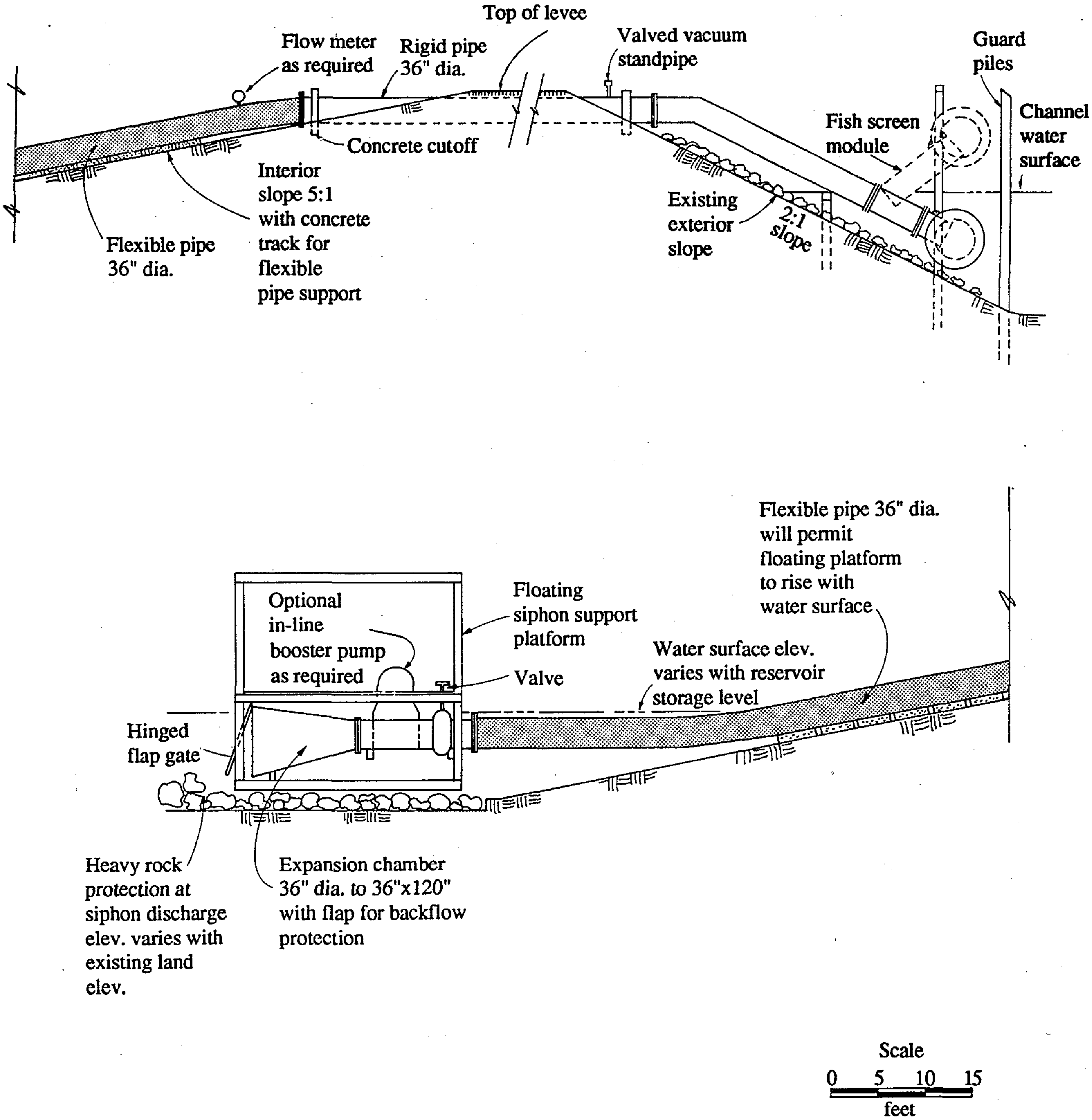
Source: Results from DeltaSOS simulation of Alternative 3 based on hydrologic record for 1922–1991 (70 years) (see Appendix A3).



Note: The interior levee slope depicted is modified by a constant-slope buttress. Levees may also be modified by a broken-slope buttress, as depicted in Appendix 2, Figure 2-6.

Appendix 2, Figure 2-1.
Siphon Station Plan View

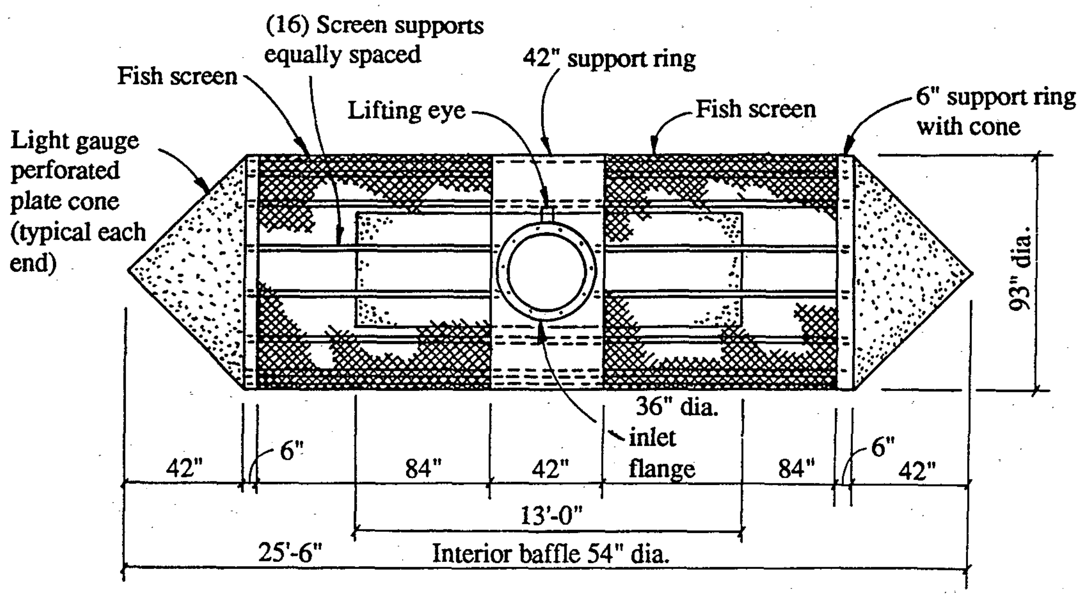
DELTA WETLANDS
PROJECT EIR/EIS
Prepared by: Jones & Stokes Associates



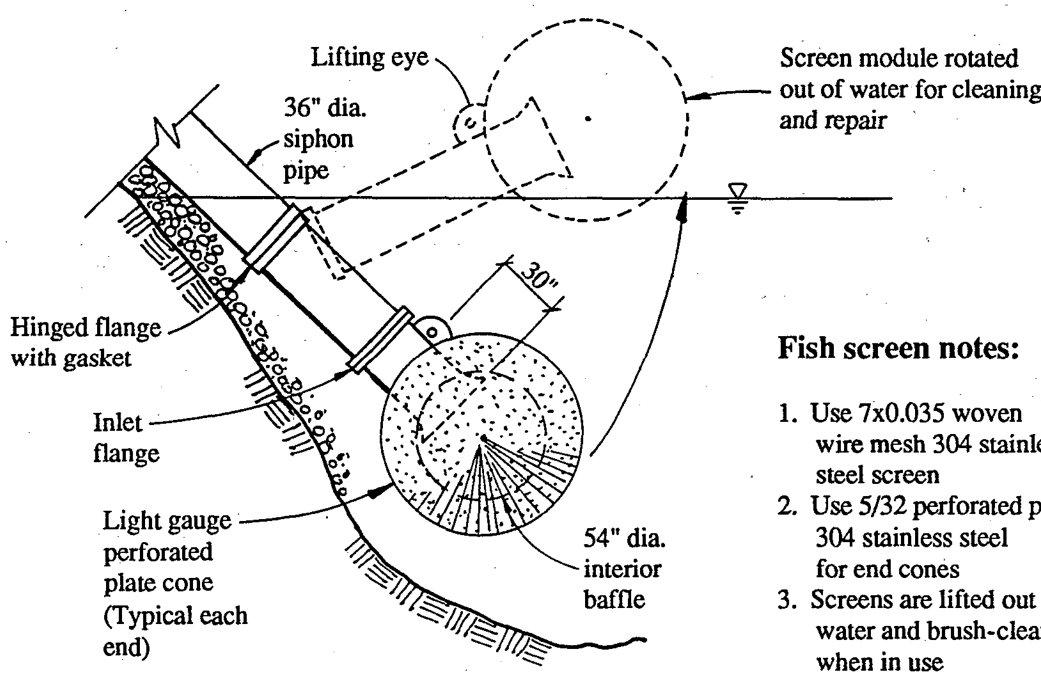
Note: The interior levee slope depicted is modified by a constant-slope buttress. Levees may also be modified by a broken-slope buttress, as depicted in Appendix 2, Figure 2-6.

Appendix 2, Figure 2-2.
Conceptual Siphon Unit

DELTA WETLANDS
PROJECT EIR/EIS
Prepared by: Jones & Stokes Associates



Front view



Side view

Fish screen notes:

1. Use 7x0.035 woven wire mesh 304 stainless steel screen
2. Use 5/32 perforated plate 304 stainless steel for end cones
3. Screens are lifted out of water and brush-cleaned when in use
4. Screens are removed from water when not in use
5. Interior baffle, 16 gauge stainless steel with 1" dia. perforations, 25% open

Appendix 2, Figure 2-3.
Fish Screen Design

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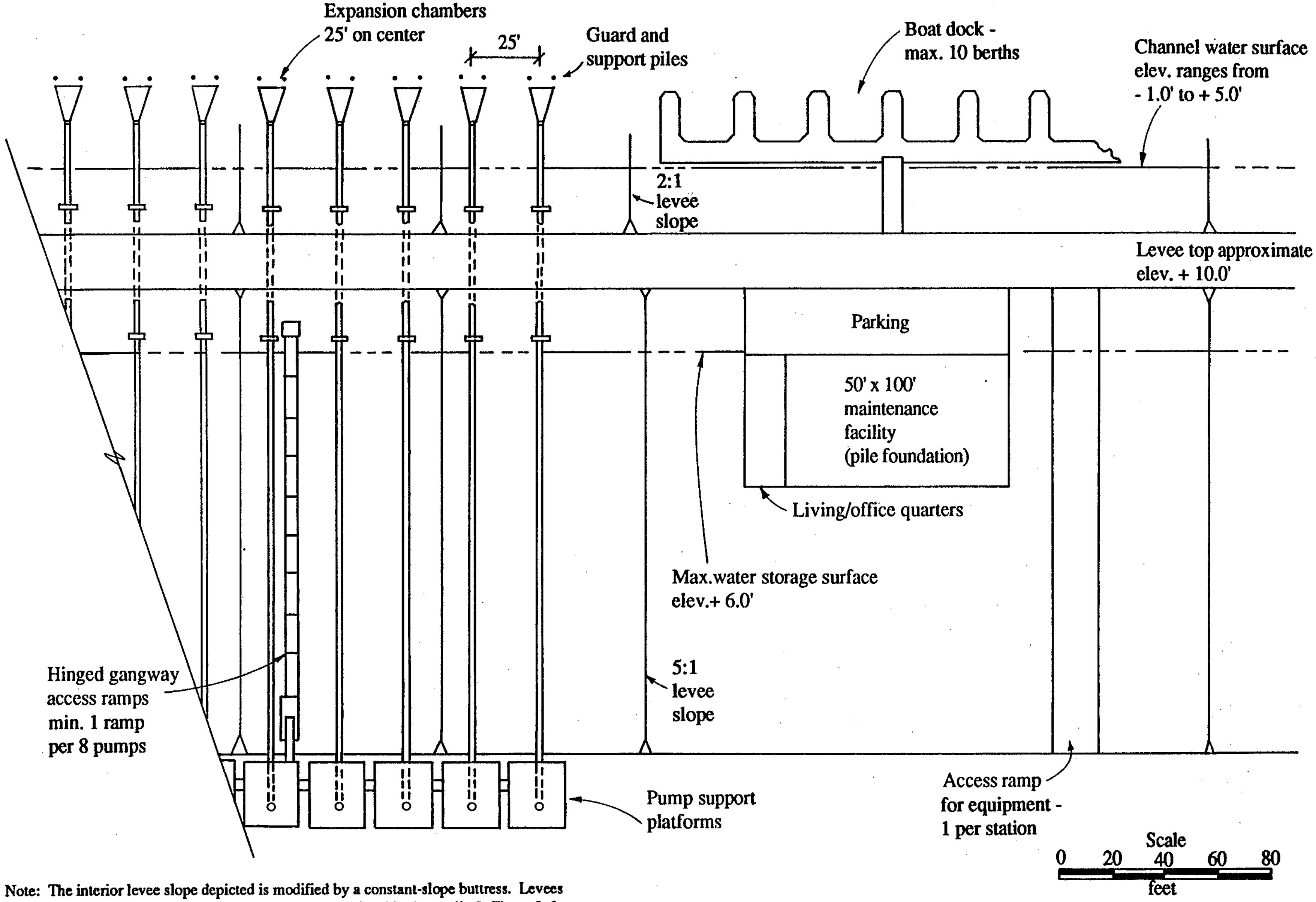

Note: The interior levee slope depicted is modified by a constant-slope buttress. Levees may also be modified by a broken-slope buttress, as depicted in Appendix 2, Figure 2-6.

Appendix 2, Figure 2-4.
Pump Station Plan View

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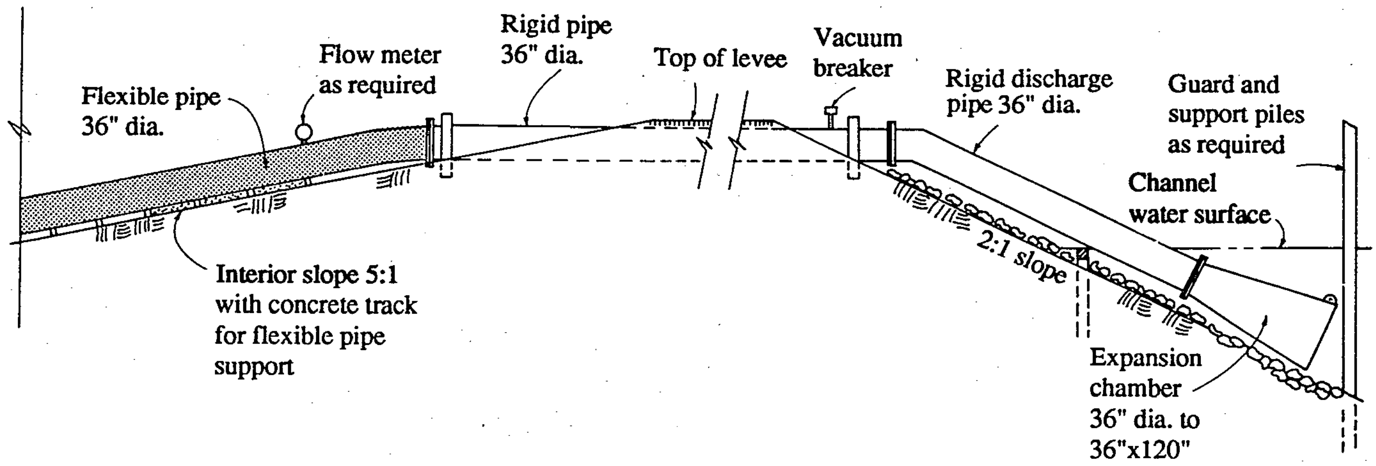

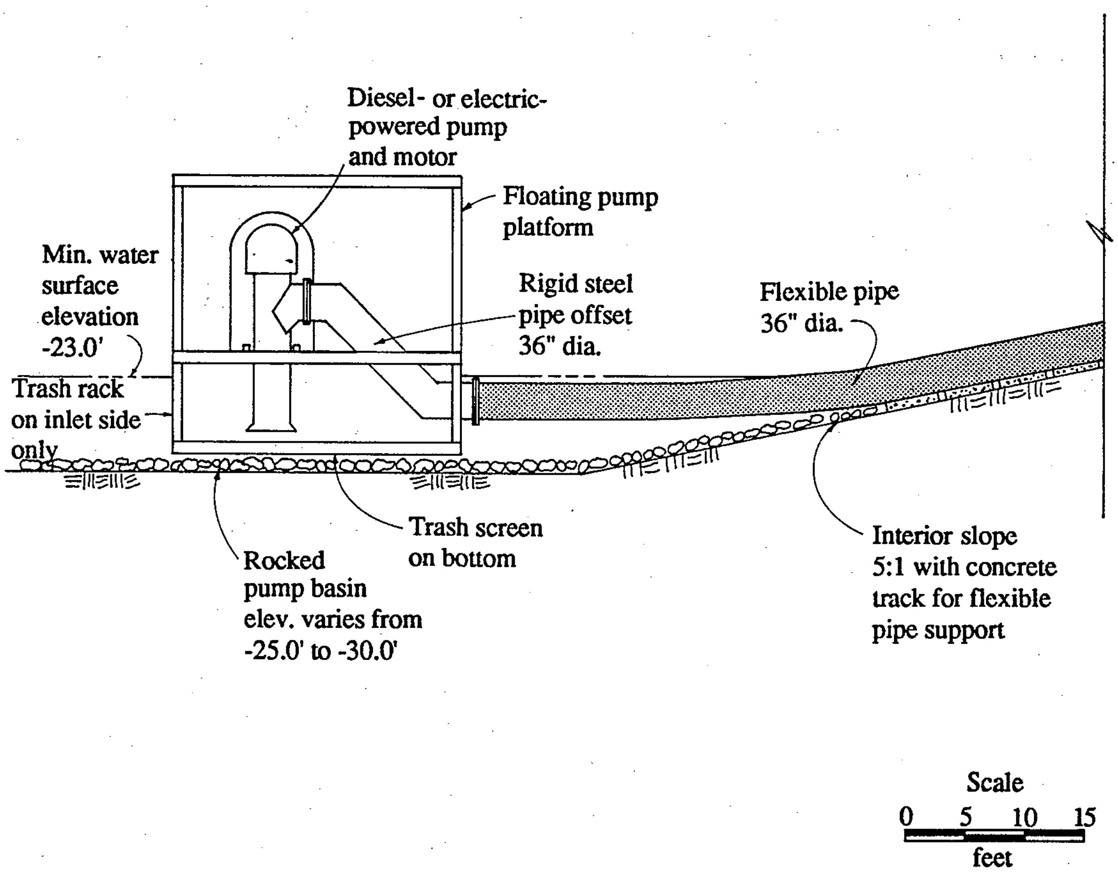

Note: The interior levee slope depicted is modified by a constant-slope buttress. Levees may also be modified by a broken-slope buttress, as depicted in Appendix 2, Figure 2-6.

Appendix 2, Figure 2-5.
Conceptual Pump Unit

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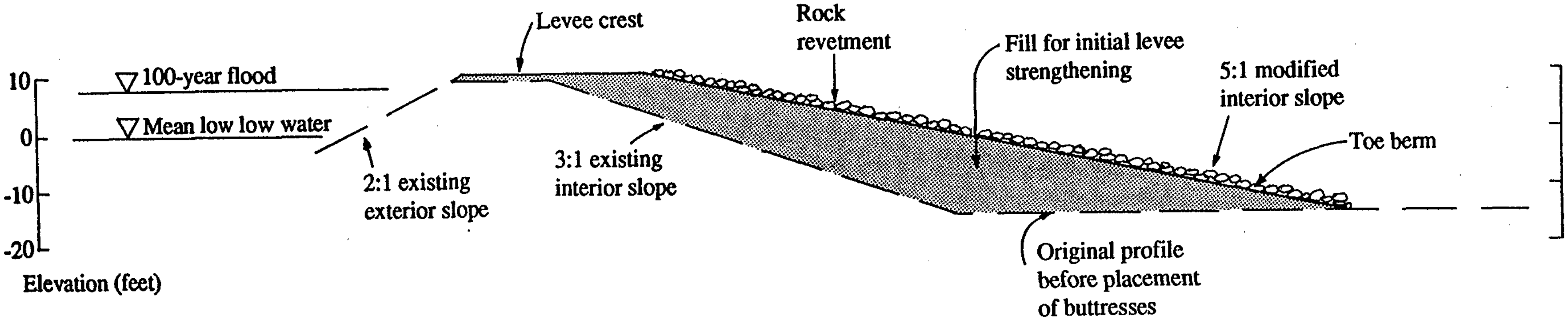
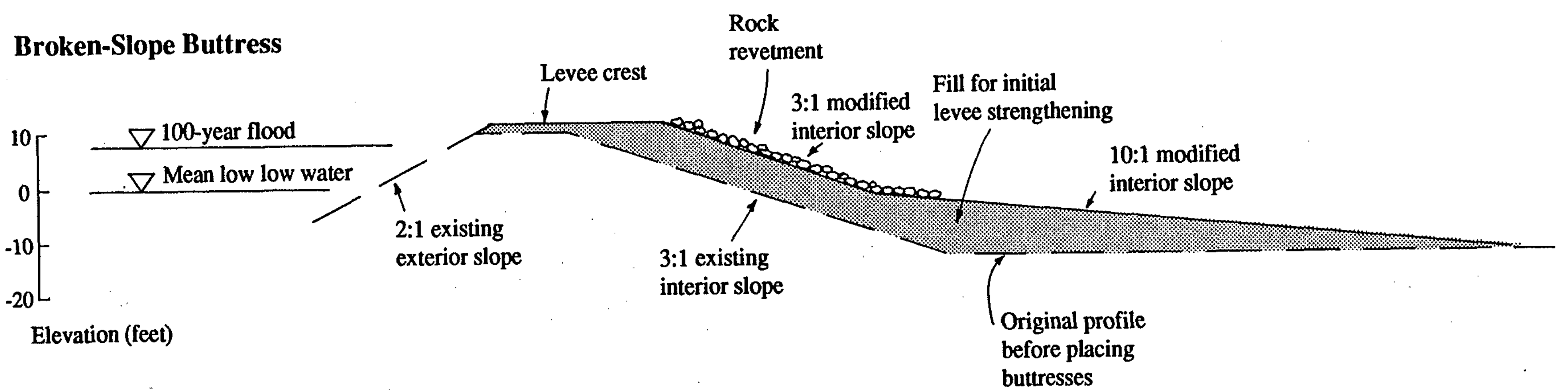
PROJECT EIR/EIS
Prepared by: Jones & Stokes Associates

C-061204

Constant-Slope Buttress



Broken-Slope Buttress



Source: Harding Lawson Associates 1993.

Appendix 2, Figure 2-6.
Examples of Levee Modification on Reservoir Islands

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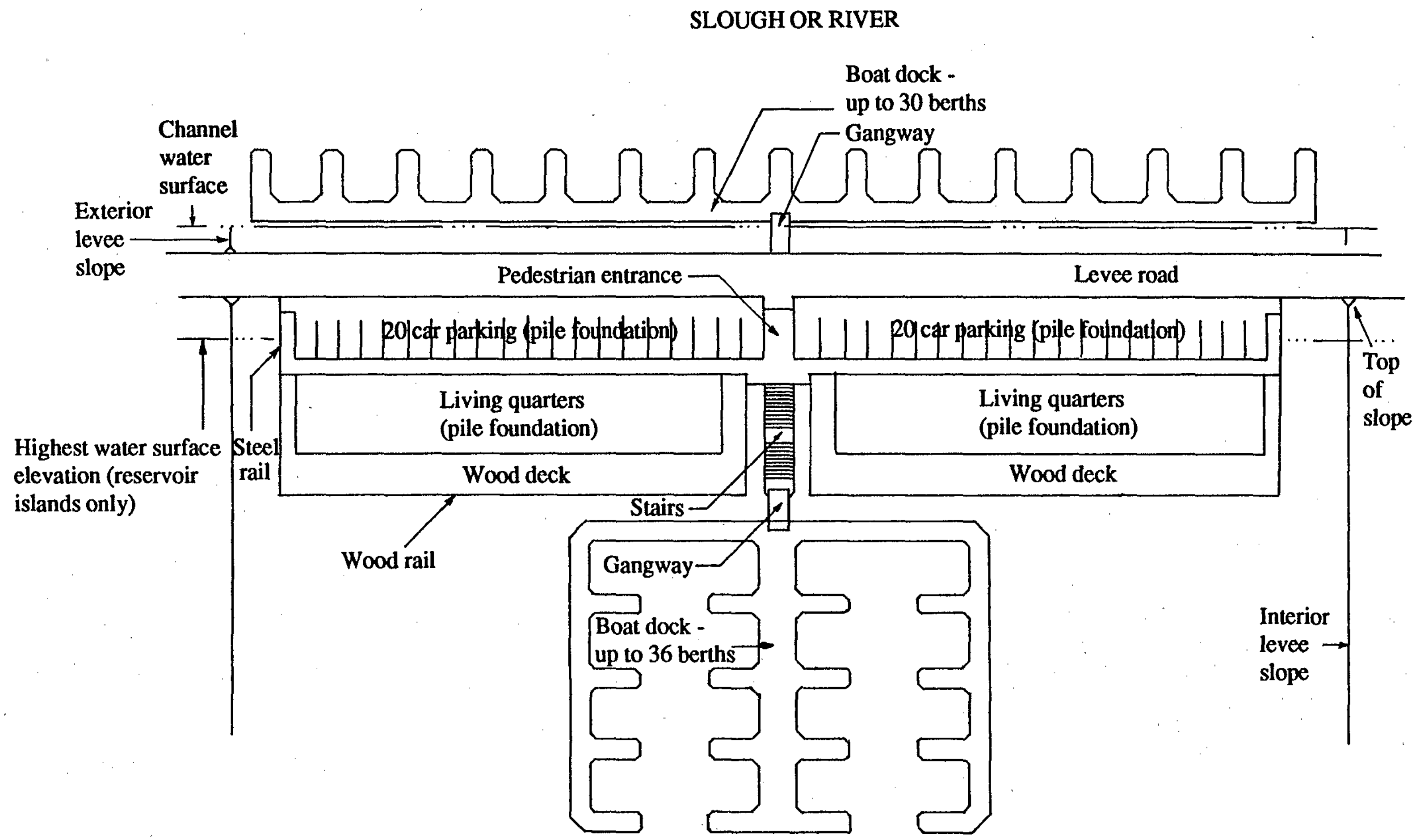
C-061204



Note: A network of ditches and canals leading from interior boat docks would provide access for small boats to island interiors on each of the habitat islands and reservoir islands.

Appendix 2, Figure 2-7.
Conceptual Recreation Facility - Plan View

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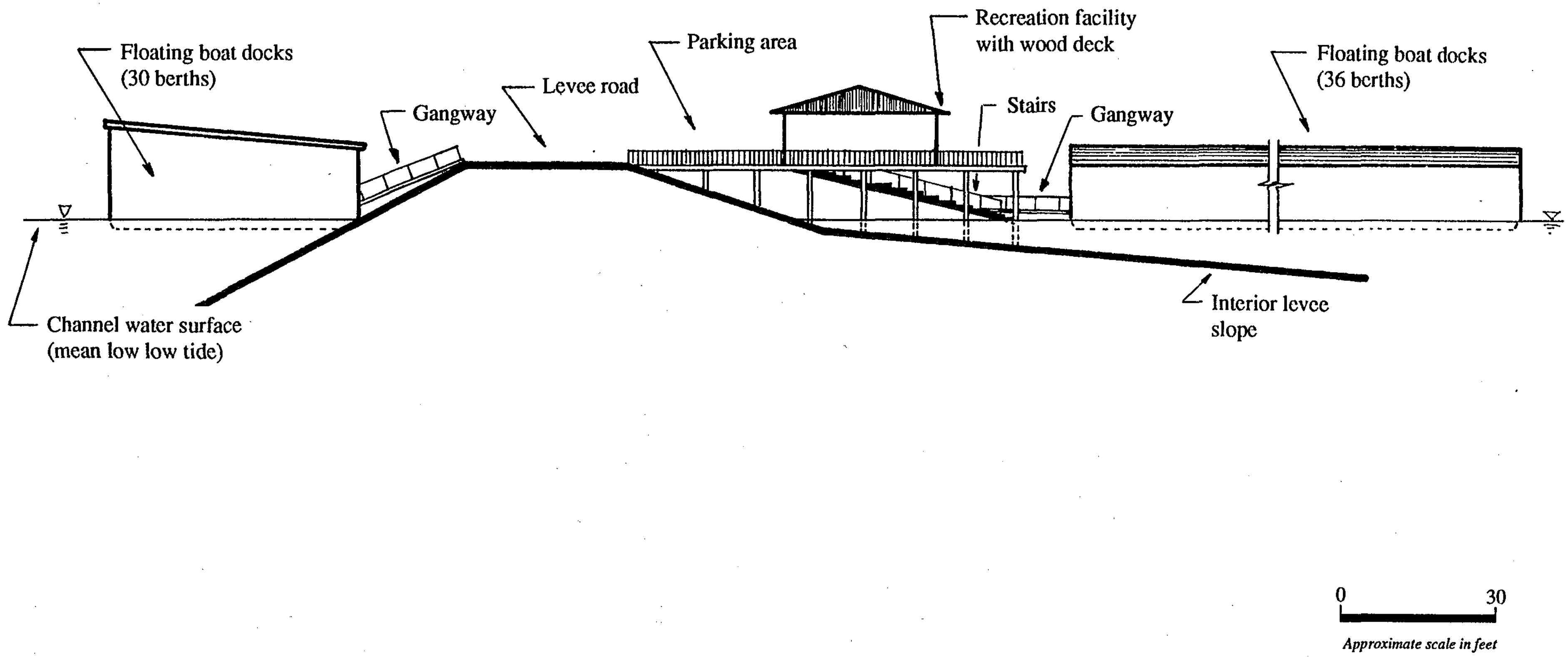
Prepared by: Jones & Stokes Associates



Note: A network of ditches and canals leading from interior boat docks would provide access for small boats to island interiors on each of the habitat islands and reservoir islands.

Appendix 2, Figure 2-8.
Conceptual Recreation Facility - Cross Section

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